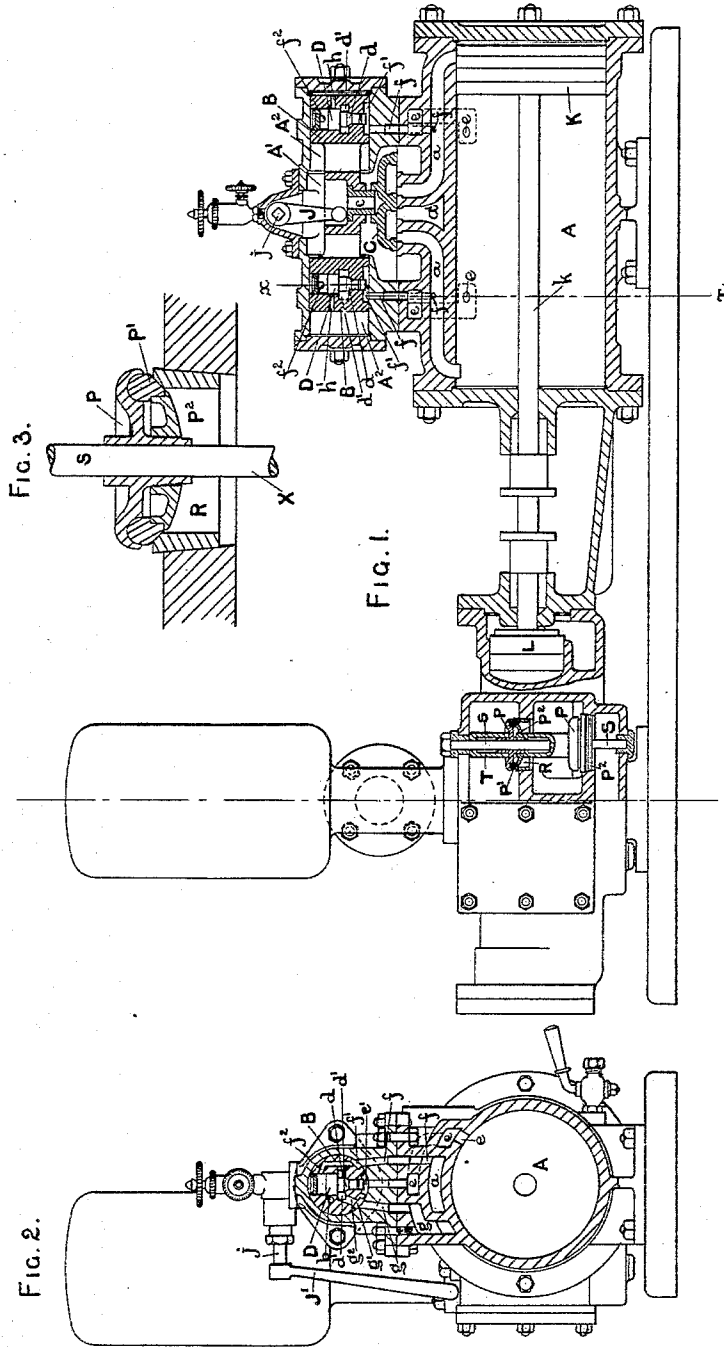


T. H. WILLIAMS.
VALVE FOR STEAM PUMPS.

No. 388,941.

Patented Sept. 4, 1888.



WITNESSES:

Edward L. Hammond.
Ernest H. Batten.

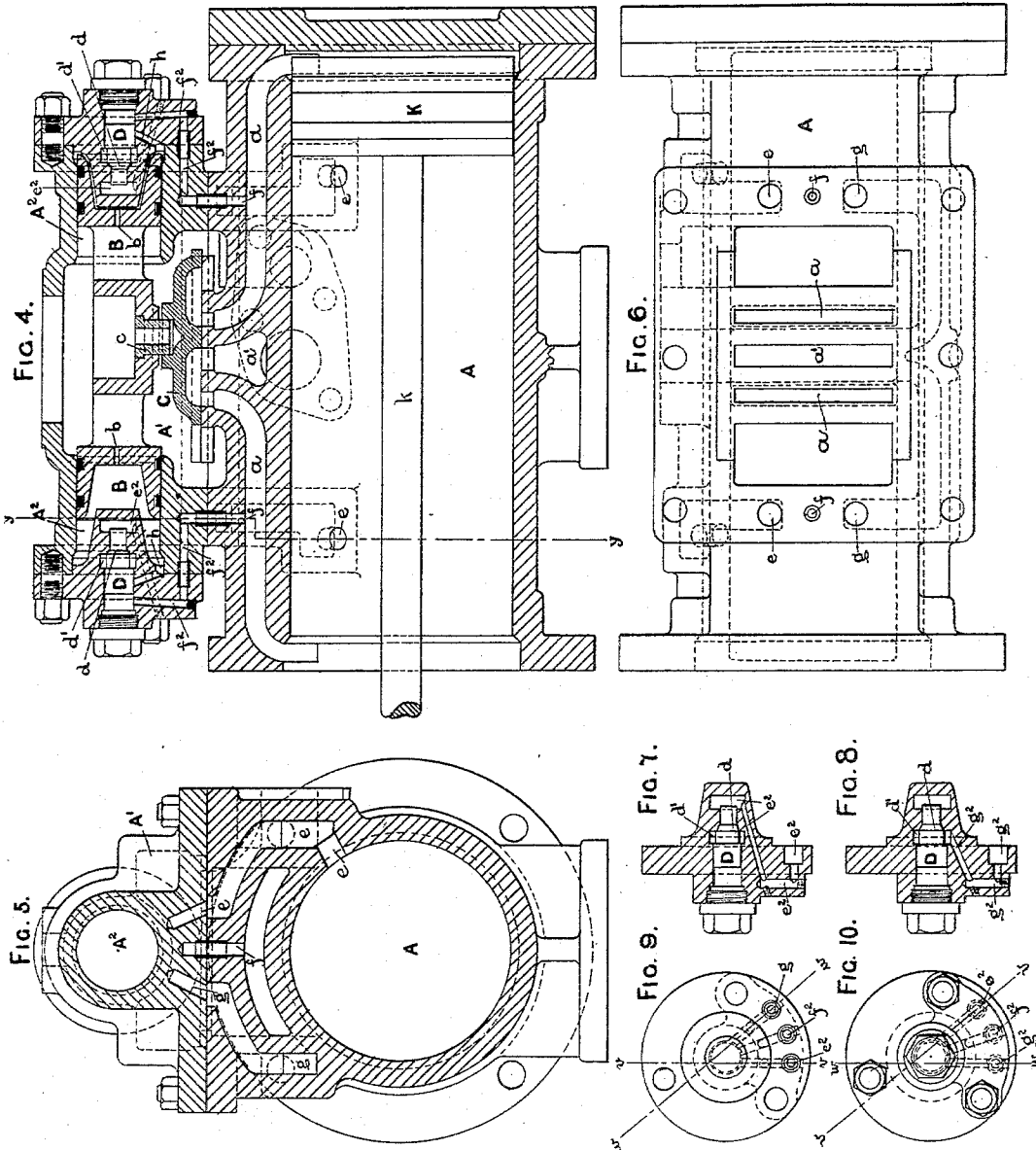
INVENTOR:

Thomas Henry Williams.
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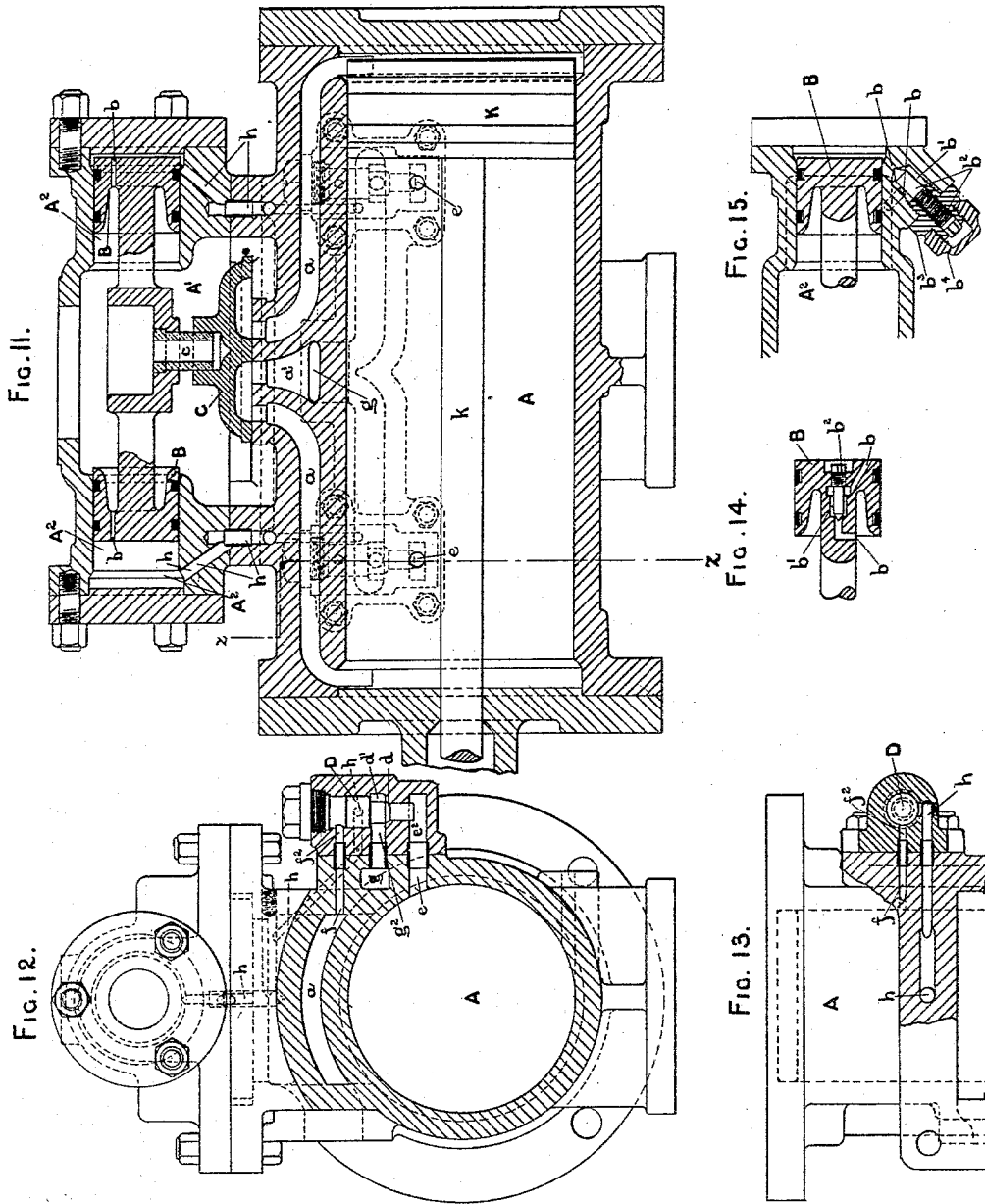
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UNITED STATES PATENT OFFICE.

THOMAS HENRY WILLIAMS, OF LONDON, COUNTY OF MIDDLESEX,
ENGLAND.

VALVE FOR STEAM-PUMPS.

SPECIFICATION forming part of Letters Patent No. 388,941, dated September 4, 1888.

Application filed November 22, 1887. Serial No. 255,945. (No model.) Patented in England May 6, 1885, No. 5,602.

To all whom it may concern:

Be it known that I, THOMAS HENRY WILLIAMS, a subject of the Queen of Great Britain, residing in the city of London, in the county of Middlesex, England, have invented certain Improvements in Valves for Steam-Pumps, (for which I have obtained a patent in Great Britain, No. 5,602, bearing date May 6, 1885,) of which the following is a specification.

My invention relates to that class of steam pumping-engines in which the main slide-valve of the steam-cylinder is actuated by supplemental pistons.

The objects of my improvements are, first, effecting the reversal of the slide-valve in a more certain, reliable, and effectual manner than has hitherto been attained with this class of pumping-engines; secondly, the prevention of the main and supplemental pistons from striking their respective cylinder ends.

I attain the first object of my invention by fitting auxiliary valves to or in connection with the supplemental pistons or their respective cylinders. The stems or stalks of these auxiliary valves communicate through suitable passages with the interior of the main steam-cylinder, and each of these passages enters in proximity to that end of the cylinder corresponding to its respective valve. The tops of the auxiliary valves communicate with their respective main steam-passages of the steam-cylinder through passages provided for that purpose, and the auxiliary valves are further encircled over a portion of their length by a suitable chamber, which is placed in constant communication with the main exhaust-port of the main steam-cylinder. Suitable passages communicate with the supplemental pistons and the said auxiliary valves and likewise with the interior of the supplemental cylinders and the main steam-chest for the admission and eduction of steam to and from the supplemental pistons for effecting their reversal.

The second object is accomplished by a suitable disposition of the steam and exhaust passages which communicate with the main steam-cylinder and the auxiliary valves and those passages which establish communication between the supplemental pistons and their re-

spective cylinders and the auxiliary valves, so as to effect the reversal of the supplemental pistons and consequently the slide-valve just before the main piston completes its stroke, thereby giving "lead" to the valve for the admission of live steam to the main steam-cylinder to arrest and reverse the main piston. The supplemental pistons are in like manner arrested either through the auxiliary valves closing the exhaust-ports of their respective supplemental cylinders and restoring equilibrium on the completion of the desired stroke or travel of the supplemental pistons, or by means of the auxiliary valves both cutting off the supply of steam and closing the exhaust-passages, (either separately or in conjunction with the said supplemental pistons,) whereby a sufficient plenum of steam or vapor is retained within the space between the supplemental piston and its cylinder-cover to absorb by its compression the momentum of the said supplemental pistons, and thus restore them to rest until again reversed by the readmission of live steam.

I carry my invention into practical effect as illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional elevation of one form of my steam-pump, in which the auxiliary valves are arranged to work in the supplemental pistons. Fig. 2 is a transverse section of Fig. 1 through the main steam-cylinder, supplemental piston, and its respective cylinder on the line $x x$, showing the steam-exhaust passages or ports. Fig. 3 is an enlarged section of one of the pump-valves, showing their construction with interchangeable beats. Fig. 4 is a longitudinal sectional elevation of another form of my steam-pump, in which the auxiliary valves are arranged to work horizontally in the covers of the supplemental cylinders. Fig. 5 is a transverse section through the steam-cylinder and supplemental cylinder on the line $y y$, showing the steam and exhaust passages. Fig. 6 is a plan of the main steam-cylinder with the steam-chest and supplemental cylinders removed, showing the main steam-ports and supplemental ports or passages. Fig. 7 is a section through the supplemental-cylinder cover on the line $v v$, showing the steam-passage which

communicates with the interior of the steam-cylinder and the stalk of the auxiliary valve. Fig. 8 is a section through the same cover of the supplemental cylinder on the line $w w$, showing the exhaust-chamber which encircles a portion of the auxiliary valve and the exhaust-passage leading therefrom to the main exhaust-port of the main steam-cylinder. Fig. 9 is an inside view of the same supplemental cylinder-cover, showing the positions of the steam and exhaust passages in the same by dotted lines. Fig. 10 is an outside view of the same cylinder-cover, with the positions of the passages or ports shown by dotted lines. Fig. 11 is a longitudinal sectional elevation of another form of my steam-pump, in which the auxiliary valves are arranged to work on the side of the steam-cylinder. Fig. 12 is a transverse section of the end of the steam-cylinder and of the case or socket of one of the auxiliary valves on the line $z z$, showing the steam and exhaust passages and the auxiliary valve. Fig. 13 is a part plan of the main steam-cylinder with the steam chest and supplemental cylinder removed, showing the steam and exhaust ports and passages in section and with full and dotted lines. Figs. 14 and 15 are views showing a device for varying the effective area of the passages for admitting steam from the steam-chest behind the supplemental pistons.

Throughout the several views similar parts are denoted by like letters of reference.

The main steam-cylinder A is fitted with the usual induction and eduction steam ports or passages, $a a$ and a' , for admitting and exhausting the steam, respectively. The steam-chest A' is formed with a supplemental cylinder or cylinders, A² A², in which are fitted supplemental pistons B B, coupled together in any convenient manner, so that they reciprocate simultaneously within their respective cylinder or cylinders. The slide-valve C may be of the single or double D form, and is operated by the supplemental pistons through a coupling-tube, e , or other equivalent device. The supplemental pistons and slide-valve are operated by a lever, J, mounted on a spindle, j , passing through a stuffing-box in the steam-chest in the usual manner and carrying a manipulating-lever, J', on the outside thereof for the purpose of starting the engine by hand. The main steam-piston K is fixed onto one end of a piston-rod, h , while the pump piston or plunger L is fixed on the other end thereof, the cylinders of both being mounted in a line with one another. These parts, and those others to which no reference is made throughout this specification, present no novel features, and may therefore be of the usual kind or type.

Referring to Figs. 1 and 2 of the accompanying drawings, it will be seen that in each of the supplemental pistons B B is mounted an auxiliary valve, D, free to work in its socket. These valves are circular in form and are of

greater diameter at the top than at the stalk, thus forming a suitable check, d , thereon, which seats onto a corresponding check formed in the valve-socket. Round that part of the auxiliary valve D where its diameter is reduced is formed an exhaust-chamber, d' , which is consequently just above the seating for the auxiliary valve. Each of the auxiliary valves D D is connected with the main steam-cylinder A, one of the induction ports a , and the eduction or exhaust port a' by three independent ports or passages, e , f , and g , the passage e connecting the steam-cylinder A with the valve-cylinder A², the passage f , connecting the induction-port a therewith, and the passage g connecting the eduction or exhaust port a' therewith. In each supplemental piston are cut or formed three longitudinal passages, e' , f' , and g' , coinciding with the three openings of the passages e , f , and g , and made of sufficient length to permit the supplemental pistons to travel their full stroke without overlapping the openings of the passages e , f , and g . The passage e' is in direct communication with the lower end of the auxiliary-valve socket. The passage f' is connected with the top of the auxiliary-valve socket by a suitable passage, f'' , and the passage g is connected with the exhaust-chamber d' by a suitable passage, g'' . Through each supplemental piston is formed or drilled a small hole, b , to allow the live steam to enter from the steam-chest A' to the spaces in the valve-cylinders A² behind the supplemental pistons, so as to place them in a state of equilibrium. The top part of each socket for the auxiliary valves is connected by a suitable passage, h , with the space in the supplemental cylinder behind its respective piston, the opening of the passage h in the auxiliary-valve-socket being in such a position that it is closed by the auxiliary valve when the said valve is down on its seating.

Referring to Figs. 4, 5, 6, 7, 8, 9, and 10 of the accompanying drawings, it will be seen that the auxiliary valves D D may be mounted in the covers of the supplemental cylinders A² A² instead of in the supplemental pistons B B, the passages or ports e , f , and g being arranged to communicate directly with the passages or ports e' , f' , and g' in the supplemental-cylinder covers in which the auxiliary valves D D work.

Referring to Figs. 11, 12, and 13 of the accompanying drawings, it will be seen that the auxiliary valves D D may also be arranged to work in sockets mounted on the side of the main steam-cylinder, the passages or ports e , f , and g being arranged to communicate directly with the passages or ports e' , f' , and g' in the sockets fixed to the side of the cylinder, the passage or port h also being modified, as shown. As it is found necessary in practice to vary the sizes of the passages b for admitting steam from the steam-chest behind the supplemental pistons, even in engines of the

same size, to obtain the most effective reversal of the same, I make the said passages larger than is actually necessary, and I provide adjustable coned screws to contract the orifices of the said passages as required. Figs. 14 and 15 of the accompanying drawings illustrate the application of the said coned screws to either the supplemental pistons or their cylinders. In the former case an annular chamber, b' , is formed in the passage b , as shown, or in any other convenient position, to allow the adjustable coned screws b^2 , contained within the head of the piston B, to vary the sectional area of the passage at any suitable portion thereof. In the latter case, as illustrated by Fig. 15, an annular chamber, b' , is formed in a snug on any convenient position outside each of the supplemental-piston cylinders A^2 . The passage b connects this chamber both with the steam-chest A and with one of the cylinders of the supplemental pistons B in the rear thereof. In this annular chamber b' is fitted a nipple, b^3 , through which the adjusting coned screw b^2 is threaded to adjust the area of the passage b , as shown. Onto a threaded extension of the nipple b^3 is screwed a cap, b^4 , which incloses the coned spindle b^2 , the threaded end of the nipple being split, so that the cap b^4 contracts the same and so locks the coned spindle b^2 . It will be seen that this device enables the area of the passage b to be varied as found necessary, while the arrangement as illustrated by Fig. 15 permits of the adjustment being effected without removing the covers of the cylinders of the supplemental pistons. When the holes or passages b are made otherwise than through the pistons B, they may communicate either with the steam-chest A' or with the steam-passages a . In either case the device for varying the size of the holes or passages, as illustrated by Fig. 15, may be arranged on any convenient part of the main or supplemental-piston cylinders, the ends of the supplemental-piston cylinders being connected with the steam-chest or steam-passage of the main steam-cylinder by suitable passages.

It will be understood that the arrangement of the auxiliary valve and of the passages or ports is identically the same at each end of the steam-cylinder.

The action of my improved steam-pump is as follows: The respective parts being in the positions shown in Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13 of the accompanying drawings, and the steam being on, steam passes under the slide valve C to the rear induction-port, a , and to the main piston K. The steam also gains access to the top of the auxiliary valve D at the rear end of the cylinder by the passage f , and so keeps it from lifting by virtue of its greater area. The exhaust-steam is at the same time passing by the front induction-port, a , and valve C to the eduction or exhaust passage a' of the main steam-cylinder. The top of the auxiliary valve D at the front end

of the cylinder is also in communication with the exhaust-port a' by means of the passages f^2 , f' and f and the front port, a , and the slide-valve C. Likewise the stalks of both of the auxiliary valves D D are in communication with the exhaust port a' by the passages $e'e'$, the passages $e e$, the main steam-cylinder A, and the front port, a . The live steam gains access behind the supplemental pistons B B through holes $b b$, thereby placing them in equilibrium. On the main piston K being driven by the entering steam from the position shown in the drawings toward the front end of the steam-cylinder and passing the rear passage, e , such a passage is opened to the live steam, which enters the same and gains access to the stalk of the rear auxiliary valve D. This valve remains stationary, however, in consequence of steam having been previously admitted to the larger end thereof. When, however, the main piston K has further traveled and passed the passage e at the front end of the cylinder, live steam gains access to the stalk of the front auxiliary valve D through the passages e and e' and lifts it, thus uncovering the hole h , and thereby exhausting the steam from the space in the supplemental cylinder behind its piston into the exhaust-chamber d' , and thence through the passages g^2 , g' , and g and the exhaust-port a' of the steam-cylinder to the atmosphere or condenser, as the case may be. The equilibrium of the supplemental pistons B B is thus destroyed, causing their reversal, and consequently the reversal of the main slide-valve C, in time to arrest and reverse the motion of the main piston without its striking the cylinder-cover, as hereinbefore explained.

When the slide-valve C admits steam to the port a at the front end of the cylinder, the steam gains access by the passages f , f' , and f^2 to the top of the auxiliary valve D, and thereby closes it. The area of this end of the auxiliary valve being greater than that of the stalk enables the newly-admitted steam to overcome the back-pressure on the stalk of the valve due to the exhausting of the steam previously admitted thereto, and thus the auxiliary valve closes quietly on its seating, at the same time closing the hole h , and thereby restoring the equilibrium of the supplemental pistons B B in time to prevent the supplemental piston from striking its cylinder-cover.

The seatings and the corresponding beats of the auxiliary valves D D are intended to check and limit the motion only of the auxiliary valves, and are not, therefore, necessarily steam-tight.

The respective positions of the ports e and f are so arranged as to give lead to the slide-valve to admit steam to the main cylinder just before the completion of the stroke of the main piston K, and thereby cushion or check its motion and prevent it striking the cylinder-covers.

In the event of wear taking place in the auxiliary valves D or their respective sock-

ets, and thereby or otherwise allowing leakage of steam to take place past the auxiliary valves, such leakage would pass into the exhaust-chambers *d'* and thence into the exhaust-passage *a'* in the manner before described, thus preventing the steam gaining access by leakage from the stalks of the auxiliary valves to the top thereof, and vice versa, and also avoiding an objectionable accumulation of pressure, thereby insuring the effective action of the auxiliary valves D at all times and under all conditions.

The relative areas of the passages *b* and *h* are so proportioned as to provide for any leakage which may take place past the auxiliary valves D or the supplemental pistons B, the passages *h* and *g* being sufficiently large to conduct away not only the normal amount of exhaust-steam but also that arising from any leakage which may take place, so that it will not impair the action of the auxiliary valves and supplemental pistons.

Pumps having the steam valves, as hereinbefore described, will only work satisfactorily in a horizontal position, though it will be obvious that by arranging the supplemental cylinders and their respective pistons at right angles to the main steam cylinder and suitably modifying the steam ports and passages to correspond such pumps will work in a vertical position.

The bodies of the pump-valves P P are formed to receive removable elastic beats P' P', which are held in position by screw-caps P² P², or their equivalent, screwed onto the bodies of the valves P P. The beats P² P² work on ordinary seatings R R, and may be guided either by a fixed spindle, S, as shown, or by webs on the bodies of the valves, if found more convenient. To assist in closing the valves, I use a spring or springs, T T, of tubular rubber, though metallic springs may be used with equal effect.

I do not claim the pump-valves as a portion of my invention, but merely show them as being a good sort of valve to use.

I am aware that prior to my invention steam pumping-engines have been made with steam-moved valves, and therefore I do not claim such a device, broadly; but,

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. In a steam pumping-engine, the combination of a main steam-cylinder provided with a piston and with steam and eduction passages, a slide-valve for distributing the steam, balanced supplemental pistons working in a separate cylinder for actuating the slide-valve, auxiliary valves controlling the motion of the supplemental pistons, and separate passages *e* and *f*, connecting the main steam-cylinder and the main steam-passages with the said auxiliary valves, whereby they are operated by the steam from the main steam-cylinder and valve-chest direct, substantially as set forth.

2. In a steam pumping-engine, the combination of a main steam-cylinder provided with

steam and eduction passages, a piston working in the said cylinder, a slide-valve for distributing the steam, separate passages *e* and *f*, leading from the main steam cylinder and the main steam-passages, the balanced supplemental pistons, and the auxiliary valves, whereby steam may be obtained from the steam-cylinder and steam-chest, and the motion of the said slide-valve controlled by the motion of the said balanced supplemental pistons, substantially as set forth.

3. In a steam pumping-engine, the combination of a main steam-cylinder provided with a piston, and with steam and eduction passages, a slide-valve for distributing the steam, balanced supplemental pistons working in a separate cylinder for actuating the slide-valve, auxiliary valves for operating the said balanced supplemental pistons, the passages *e* and *e'*, connecting the said valves with the steam-cylinder, the passages *f*, *f'*, and *f²*, connecting the said valves with the main steam passages of the main cylinder, and the passages *g*, *g'*, and *g²*, connecting the said valves with the exhaust-passages of the cylinder, substantially as and for the purpose set forth.

4. In a steam pumping engine, the combination of a main steam cylinder provided with a piston, and with steam and eduction passages, a slide-valve for distributing the steam, balanced supplemental pistons working in a separate cylinder for actuating the slide-valve, and provided with the holes *b* for steam, the holes *h* for the exhaust, the longitudinal passages *e'*, *f'*, and *g'*, and the exhaust chambers *d'*, the auxiliary valves D for operating the said balanced supplemental pistons, the passages *e* and *e'*, connecting the said valves with the main steam-cylinder, the passages *f*, *f'*, and *f²*, connecting the said valves with the steam-passages of the main steam cylinder, and the passages *g*, *g'*, and *g²*, connecting the said valves with the exhaust-passage of the main steam-cylinder, substantially as and for the purpose set forth.

5. In a steam pumping-engine, the combination of a main steam-cylinder provided with a piston and with steam and eduction passages, a slide-valve for distributing the steam, balanced supplemental pistons working in a separate cylinder for actuating the slide-valve, auxiliary valves working in sockets formed in the balanced supplemental pistons, the passages *e* and *e²*, connecting the said valves with the main steam-cylinder, the passages *f* and *f²*, connecting the said valves with the steam-passages of the main cylinder, and the passages *g* and *g²*, connecting the said valves with the exhaust-passage of the main steam-cylinder, substantially as and for the purpose set forth.

6. In a steam pumping-engine, the combination of a main steam-cylinder provided with a piston and with steam and eduction passages, a slide-valve for distributing the steam, balanced supplemental pistons working in a separate cylinder for actuating the slide-valve

and provided with holes *b* for steam, the effective areas of which can be varied, the coned screws *b*², auxiliary valves working the said balanced supplemental pistons, and separate
5 passages connecting each of the said valves respectively with the steam-cylinder, the steam-passages of the main steam-cylinder, and the exhaust-passage thereof, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed to my name in the presence of two subscribing witnesses.

THOMAS HENRY WILLIAMS.

Witnesses:

ROBT. ED. PHILLIPS,
CHAS. BERKLEY HARRIS,
Notary Public, London.